



**NTSB** National Transportation Safety Board

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*Office of Railroad, Pipeline &  
Hazardous Materials Investigations*

**Macdona, Texas**

Hazardous Materials





Car #16 - Chlorine

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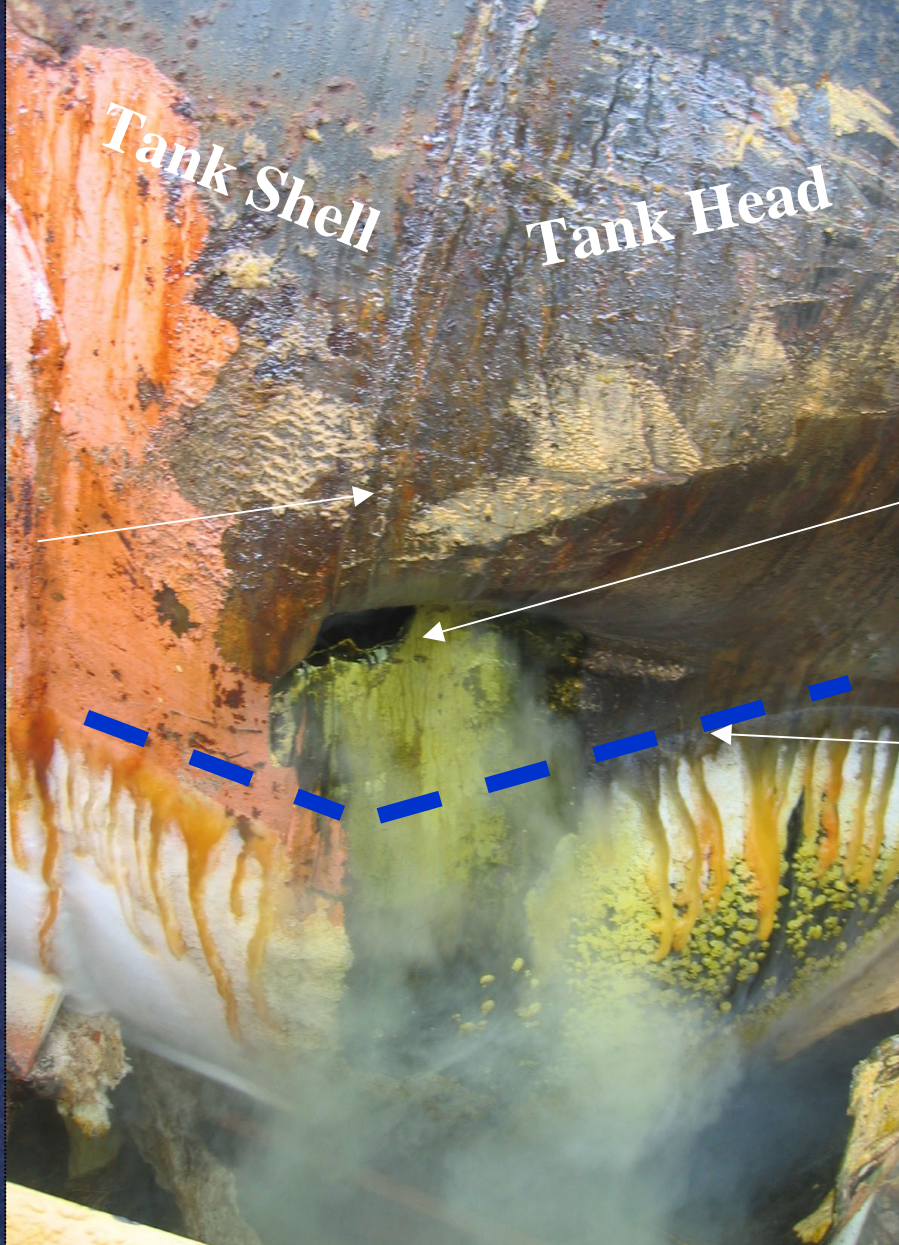
# Chlorine Release

- Tank car loaded with 90 tons of liquefied chlorine
- About 60 tons of poisonous liquefied chlorine gas released
- Immediately vaporized and engulfed derailment site within 700 ft
- Drifted 10 miles northwest

# Chlorine Gas

- Transported as a compressed liquefied gas
- Poisonous by inhalation
- IDLH - 10 ppm
- EPA estimated concentration around 400,000 ppm





Weld Seam

Tank Shell

Tank Head

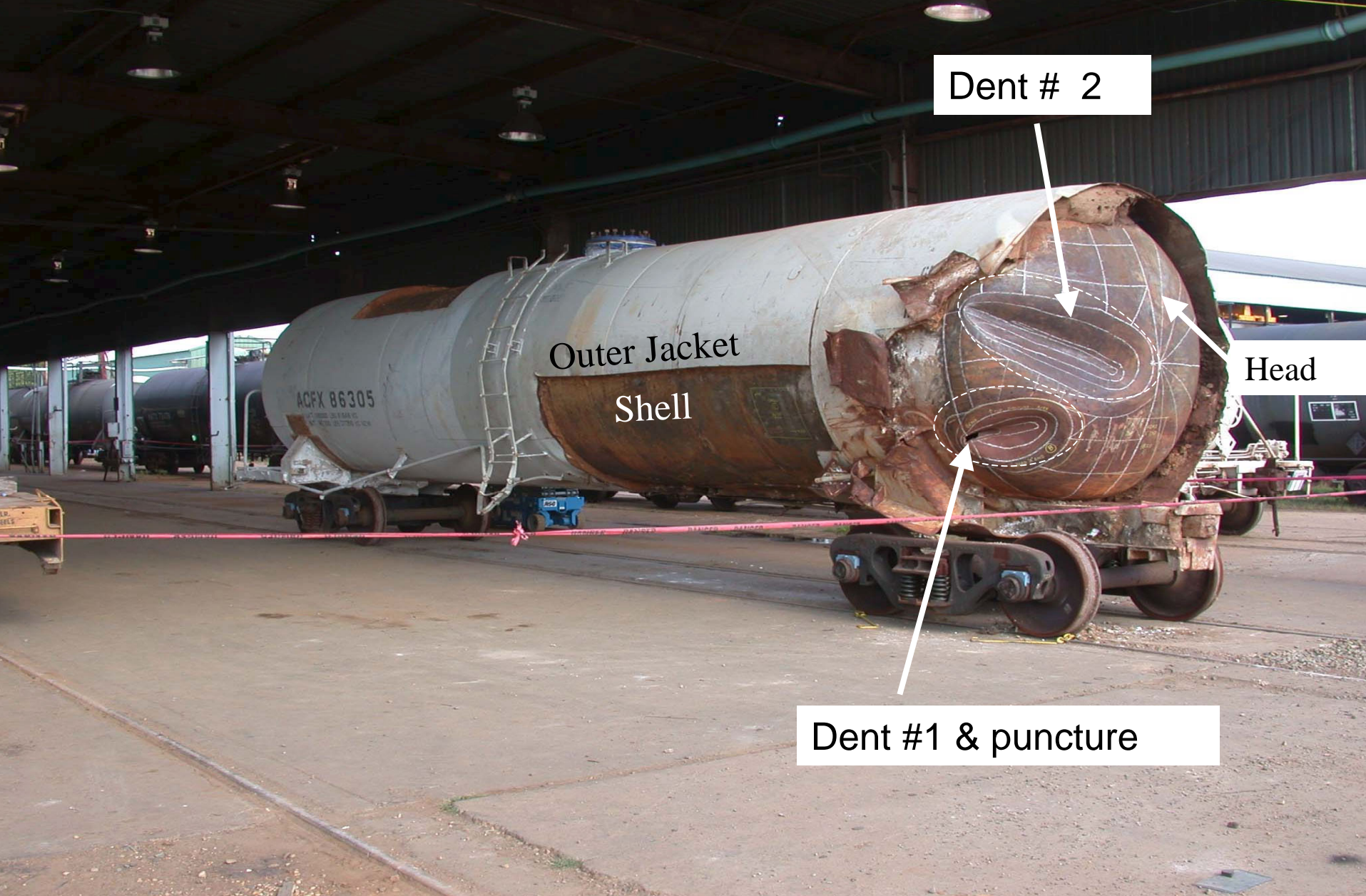
Puncture  
(2" x 11')

Frost Line

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Dent # 2

Outer Jacket  
Shell

Head

Dent #1 & puncture

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# Punctured Tank Car

- Manufactured in 1976
- Insulation & outer steel jacket
- Tested to 500 psig
- Tank Shell
  - $\frac{3}{4}$  inch thick
  - Non-normalized steel
- Tank Heads
  - $\frac{13}{16}$  inch thick
  - Hot formed steel



# Tank Car Performance

- Tank head
  - DBTT < - 40 ° F
  - Ductility limited puncture
- Tank shell
  - DBTT > 85° F
  - Brittle under most operating conditions



# Tank Car Performance Cont'd

- Charpy impact energies lower than some of the Minot tank cars
- Fracture toughness of the steel from the Macdona tank car inferior to the steels from some of the Minot tank cars



# Conclusion

The tank car shell involved in the Macdona accident would have been susceptible to catastrophic fracture if the shell had experienced a large penetration of several feet or more across the shell.



# Previous Recommendations

Low fracture toughness of tank car steels  
Minot, North Dakota

- Updated evaluation of FRA progress to implement safety recommendations
- Reiteration of tank car safety recommendations



# Previous Recommendations Cont'd

Vulnerability of tank cars transporting poisonous gases – Graniteville, SC

- Recommendation to FRA to mandate operational measures (tank car placement and restricted speeds)
- Prompt action required





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